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Hydropower as an Important Renewable Energy Source

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Abstract: Renewable energy sources represent an issue which, nowadays, is earning more and more attention by people, governments, institutions and international organizations. This issue has been at the centre of many conferences, international conventions, binding legislations and voluntary standards. Renewable energy sources are part of the energetic sector, but they can be considered, more appropriately, a specific part of the mentioned sector as they are all characterized by one feature: they are environmentally friendly ways of producing energy. In other words, renewable energy sources are means to produce energy that do not imply the exploitation of finite sources, such as oil or carbon, but exploit energy coming from the sun, Earth, winds, biomasses. This sector is rapidly growing, as recently RE sources have reached the 13% of the total energy sources and now they are even more used. This paper has the aim to analyse and classify REs and the Italian situation referred to green energy, showing many successful cases of hydropower plants in different Italian regions. Thus, the installed power and the environmental conditions of different Italian regions are illustrated, comparing the different results and potentialities related to each region. It is possible to state that, generally, Italy has seen different stages of development of green energy, with relevant differences among its regions.

Keywords: Hydropower, Electric Energy, Italian Regions, Environmental Impacts, Renewable Sources

1. Introduction

Hydropower is part of the group of the so called "RE", together with photovoltaic energy, biomasses and many others. It is the most spread renewable resource used and plays an essential role in many regions. As a result, it is an important renewable energy resource worldwide and one of the eldest too. As a matter of fact, Man has always been trying to use as many sources of energy as possible, apart from his own muscles. A very long time ago, man was attracted from the power produced by flowing water and developed different systems to use the potential and kinetic energy of water to activate (potentially without any limit) millstones, olive-presses, sawmills and so on. Over time, man has learned to turn the power of water into electricity solving a relevant problem: the above-mentioned machines could be built only near to watercourses. The use of electricity, on the other hand, has entailed the development of more and more advanced energy production systems until the current state of technology. Indeed, until 70s, in Italian rural areas, it was normal to find water mills based on traditional technologies. But, in the last century, the levels of awareness of water potential are improved and have entailed the use of this resource at almost its potential [1]. Nowadays the success of this way to produce energy is due to the fact that it does not depend on periods of crisis, on prices, political choices, cartels and so on, but only on the presence of water in a certain area. Water is contemplated as one of the most environmental-friendly sources of energy (so, hydropower has an ethical value too) and is seen as a mean to reach aims in a global, general, view.

The ten-years strategy "Europe 2020"[2], in 2010, fixed the following well-known objectives to be reached within 2020:

(1) The reduction of greenhouse gases by 20%;
(2) The reduction of energy consumption by 20%;
(3) The fulfilment of 20% energetic needs through renewable sources.

These aims have been translated in Italy in: gaining 13.4% in terms of energetic efficiency and reliability on renewable energy sources that should produce at least the 17% of the total amount of energy. In these circumstances, hydropower plants play an important role, in order to efficiently reach the previously pointed out objectives, and governments have started to offer incentives to this form of energy production.

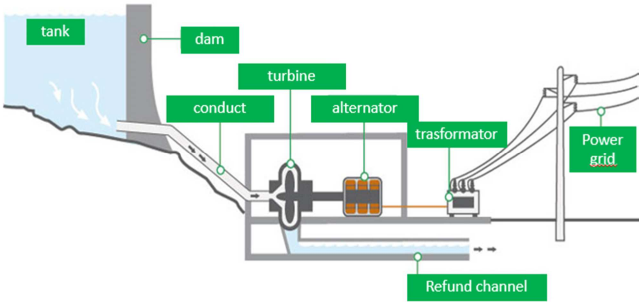
2. Hydropower: An Overview

Hydropower technologies are used for both storage and production of energy. Hydroelectric plants use the potential energy of water, due to the different heights of the waterflow and the turbines of the plant. Potential energy is then turned into mechanical energy by the turbines themselves and, consequently, into electric energy through a generator. Pumping plants are used to store energy and are characterized by the presence of two stages: during the off-peak periods energy is pumped, whereas during periods of high demand levels, energy is released through the turbines and then commercialized at high prices. More specifically, there are eight steps for the production of energy from water:

(1) Entrance of water into the process;
(2) Channelling of water;
(3) Creation of a water reserve;
(4) Forced conduit (for high falls);
(5) Turbine working thanks to mechanical energy;
(6) Generator transforming mechanical energy into electricity;
(7) Control system and transformer;
(8) Dumping water.

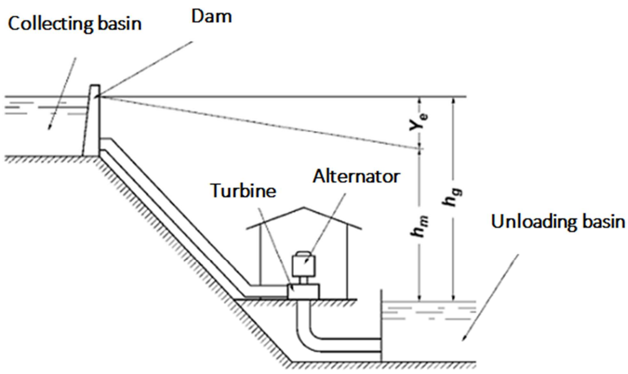
The production of hydropower can be based on many different sources, such as natural streams and rivers, irrigation and remediation canals (with little differences of heights and low impacts on the environment), aqueduct (with minimum or zero environmental impact), waste water, industrial discharges and so on [3]. However, what matters is the presence of two different heights (the so-called "head") and the flow rate. The former is the difference in terms of height between the surface where water is and the section of the water flow where water falls and it is strictly related to the territory, the latter is the volume of water that crosses a certain sector of the water flow in a unit of time. Hydroelectric plants can be classified into: Small Hydro Power (SHP) (with a power lower than 10 MW), mini (2MW) and micro hydro plants (100kW). Another possible classification is: run-of-the-river plants, basin plants, pumping plants and hydric conducts plants. The former uses the instantaneous flow rate until the limit of the plant, usually with low heads and high powers.

Basin plants are characterized by the presence of a basin where water is collected so as to manage the hydropower produced with high flexibility: the basin collects water during a certain period, then this water is used when electricity is needed. Pumping plants are characterized by a basin from which water outflows producing electricity: there are two containers linked by tubes that make the difference between this model and the previous one. As a matter of fact, in this model the water flow can be inverted, from the lower container water can flow to the upper container if there is no demand for energy.



Source: revision from www.everenergy.it

Figure 1. *Run-of-the-river plants scheme [4].*



Source: www.itimarconinocera.org

Figure 2. *Pumping plants scheme [5].*

Hydric conduct plants have been taken into account only recently: cities are equipped with potable water using the water of a container through a conduct. In this case, the aim of the plant is not to produce energy but, to avoid the energy dissipation during the flow of water inside the conduct, it is possible to insert a turbine exploiting the energy produced by flowing water.

A turbine can work for 40 to 80 years, according to the technology and the efficiency of the pumping system (and, of course, the quality of the project). Fortunately, during the last 25 years, the efficiency of the cycle "pumping- energy generation" increased by 5%.

In 1997, a survey conducted by The International Journal on Hydropower & Dams found that 50% of national electricity production in 63 countries and 90% in 23 countries is supplied by hydro. Although these surprising results, world hydro potential is not totally exploited (particularly in Asia, Latin America and Africa) [6]. The following image is to give evidence to what has been previously discussed.

Table 1. *Hydroelectric potential vs hydroelectric production in many regions.*

Region	Gross theoretical potential (TWh/year)	Hydro Power Production (TWh/year)
North America	5817	697
Latin America and Caribbean	7533	519
Western Europe	3294	48
Central and Eastern Europe	195	27
Former Soviet Union	3258	498
Middle East and North Africa	304	66
Sub- Saharan Africa	3583	225
Centrally Planned Asia	6511	226
South Asia	3635	105
Pacific Asia	5520	41
Pacific OECD	1134	129
World Total	40784	2581

Source: HERZOG A.V., LIPMAN T.E., KAMMEN D.M., Renewable Energy Sources, Encyclopedia of Life Support Systems (EOLSS) Forerunner Volume "Perspectives and Overview of Life Support Systems and Sustainable Development", p. 40.

It is expected that soon hydro will be the preferred source of electricity for developing countries possessing water resources as it is the most efficient way to generate electricity: modern hydro turbines can convert as much as 90% of the available energy into electricity (more or less 40% more efficient than fuel plants). Moreover, this sector is starting to expand to use the strengths and synergies with sea waves, tides and streams.

The most involved industrial sectors in this kind of energy source are: the building sector, the touristic- recreative one and the hydro-supply services related to industries, agriculture and civic use.

3. Advantages and Disadvantages

As any other kind of energy source, hydropower entails advantages and drawbacks. Although it has been estimated that drawbacks are relevant, especially if compared to the ones of other renewable energy sources, advantages are major. As a matter of fact, it is evident that the production of energy from water depends on the building of plants (and when talking about plants, very large plants are meant) that totally change the landscape (but allows the local population to control periods of overflows). On the other hand, if compared to the photovoltaic, these plants do not need the light of the sun to produce energy, so their potential is fully used and allows a greater production of energy. If it is not enough, hydropower can be compared to geothermal: in this case, hydropower wins too because it can be implemented in more areas than geothermal energy. Moreover, water energy does not depend on the fluctuations of prices of something as it happens for biomasses (that, on the contrary, depend on the price of fuel and need to always check the levels of the produced gases) [7]. To sum up: if wanting to produce clean energy from water, it entails elevated initial resources (in terms of money and investments), nonetheless the initial elevated extra costs are then covered by the very efficient and effective production of energy.

Although hydroelectricity is usually considered a clean energy source, it is not totally true as greenhouse gas emissions, according to many researches, are not considerably reduced (as thought previously), even though they are related only to the construction of the plants. Moreover, these plants are usually built in poor inhabited rural areas, reducing biodiversity and fish populations, the quality of water with all the related consequences. It happens when hydropower plants are built in non-controlled areas, poor countries without sustainable projects and plans to save the environment around the plant. The use of water causes the hydro-depletion of (usually) isolated lands in favour of others, until the disappearance of many species due to the construction of roads, power lines, service infrastructures apart from the construction of the plant itself. However, as there are no other consequences related to hydropower plants (no high air pollution, no relevant noises or emissions of polluting particles as for traditional sources of energy), the European Union has calculated that, to reach the previously mentioned aims, hydropower will have to increase by 16.000 MW through new mini and micro plants [8]. As a matter of fact, hydropower plants do not entail the production of pollutants as it is for fuel, they do not cause air pollution (CO_2 deriving from combustion, NO_x due to heating systems, O_3 due to industrial activities, or benzene, C_6H_6, deriving from oil refining processes), nor soil or water pollution (as it happens with oil tankers), without any illnesses caused by them. At this moment, the greatest producer of hydropower is China, with a production of 652 TWh per year.

To face the mentioned problems, in Italy there is the willingness to create a unique standard to keep acceptable environmental conditions and biodiversity in the areas influenced by the presence of water plants (the so-called Deflusso Minimo Vitale, DMV, or minimum vital outflow) The aim of the standard, already defined locally by different Italian regions, is to contrast [8].:

(1) The reduction of the available habitats and their variety;
(2) The reduction of the variety of biodiversity;
(3) The undesired evolution of plant life in certain areas;
(4) The interruption of hydraulic continuity;
(5) Sudden variations of range (hydropeaking);
(6) Alterations on the distribution and transportation of nutrients and organisms;
(7) Obstacles in migrations of fish fauna.

4. The Current Italian Situation and Comparisons

In Italy, the hydropower sector has faced many difficulties and problems concerning bureaucracy and authorization procedures, more than technological barriers, despite the reduction of building and installation costs should have simplified and allowed the spread of this RE. Although smaller turbines and plants have been created, the environmental impact hasn't been considerably reduced, because of the very low attention on the environment when implementing this RE. Nevertheless, Italian Industry is very well known for the technologies applied to hydropower: many cases of excellence are Ansaldo Energia, Impregilo, University of Padova and RSE. Although great plants can be found in Italy, it is in the Eastern and South American regions that the biggest plants are: in China, Brazil, Paraguay, Venezuela, United States, Russia and Colombia[41]. Moreover, if compared to European countries, the situation of pumped hydro energy storage systems in Italy is not so far from the one of other countries, especially if it is considered that Italian energy production is much lower than the rest of European countries. So, in terms of values, Italy produces less hydropower than Norway, France, Sweden and Turkey but, in terms of percentages (amount of hydropower related to the total amount of produced energy) Italy has a good advantage on others. The situation, in terms of hydropower production in Europe can be represented as follows [9]:

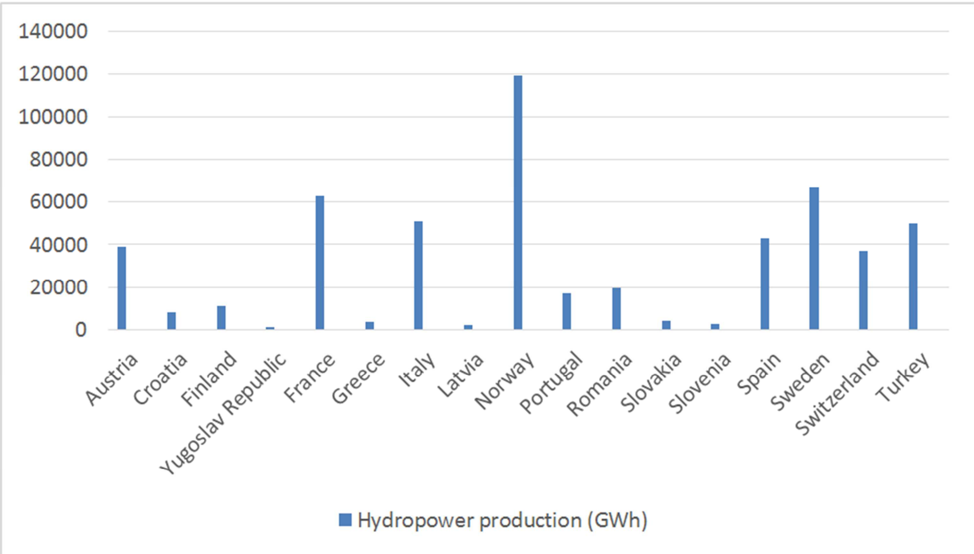


Figure 3. *Approximate European production of hydropower in 2010.*

Source: Regione autonoma Friuli-Venezia Giulia, Valutazione del potenziale idroelettrico, Progetto co-finanziato dall'Unione Europea. Fondo europeo per lo sviluppo regionale (FESR). Programma Interregionale IV° Italia – Austria 2007-2013, p. 10.

As far as it concerns implementation costs, it is possible to classify them into investment and operative ones. The former includes: feasibility studies, development and authorization costs, general costs for rivers depuration and similar, plant building, others. The latter can be summarized as follows: costs concerning the use of land, insurance costs, labour costs and administrative ones, costs for the connection to the transmission network and others. In Italy, these costs can be identified like this [10]:

Table 2. *Investment costs according to the installed power.*

	Installed power (MW)			
	0.4	**3.3**	**4.2**	**15**
Investment costs (€/kwW)	4.120	2.150	4.500	2.500
Working hours per year (Hours/year)	4.000	40	4.700	2.900
Operative costs per year (€/kW)	280	1.7	80	60
Operative costs per year (% investment costs)	6.2	0	1.8	2,4
Expected life (years)	30	30	30	30
Value at the end of life (% investment costs)	30	30	30	30
Total cost (€c/kWh)	17.42	10.5	10.6	9.6

Source: re-elaboration from LORENZONI A., BANO L., I costi di generazione di energia elettrica da fonti rinnovabili, GSE Conference, October 2007.

As a result, the more organizations invest on hydropower, the more hydropower plants earn in terms of efficiency and production and, as a consequence, it is possible to say that there is an inverse relationship between costs per unit (€/W) and production (kW).

The Italian energy demand is mainly satisfied by foreign countries: Italy depends on others for the 85% of its needs, whereas other European countries have a higher rate of independence, equal to 57%. The causes can be identified in the very low national energy production but, in terms of RE, it has increased by 45% from 2007 to 2010 (with a major contribute from Friuli-Venezia Giulia), which means that renewable energy systems have earned a major relevance in terms of gross domestic energy consumption (24% of it) [11].

This gross domestic energy consumption can be represented as follows:

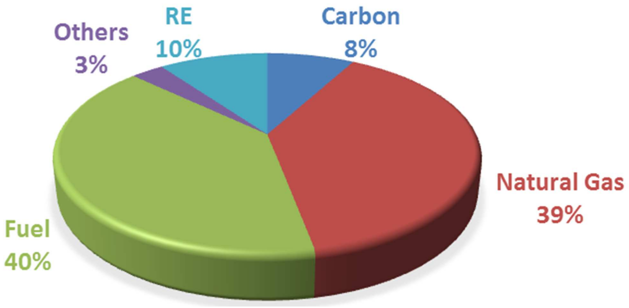


Figure 4. *Gross domestic energy consumption in 2010.*

Source: Regione autonoma Friuli-Venezia Giulia, Valutazione del potenziale idroelettrico, Progetto co-finanziato dall'Unione Europea. Fondo europeo per lo sviluppo regionale (FESR). Programma Interregionale IV° Italia – Austria 2007-2013, p. 10; 11.

Dams with a power equal to 88 MW represent the 44% of the total amount of installed power in Italy, whereas the remaining amount of installed power is produced by smaller with run-of-the-river generation plants (366 kW). Forty-seven of the 65 new plants implemented in 2009 are run-of-the-river generation ones, with a power lower than 1 MW and, as small plants best suit Italian geographical features, in the future there will be an increasing amount of small plants. The greatest part of hydroelectric dams and plants are in the northern regions, as they are more appropriate for these forms of energy production, thanks to their environmental and orographical conditions. To sum up, Italian hydropower plants can be classified as follows [12]:

Table 3. *Number of plants and installed power in Italy in 2016.*

Power	Number
$P \leq 1$ MW	2745
1 MW $< P \leq 10$ MW	872
$P > 10$ MW	303
Total	3920

Source: Gestore Servizi Energetici (GSE), Energia da fonti rinnovabili in Italia, Rapporto statistico, 2016, p. 78.

If comparing these data with the ones from the 2003 on, it can be seen that the number of plants has passed from 1.998 to 3.920 with an effective power increasing from 16.970 MW to 18.641 MW.

5. The Situation in Some Italian Regions

The Italian territory is characterized by a wide variety of environments, landscapes, resources, types of climate, mentality and approach to the primary, secondary and tertiary sector. These differences have entailed different stages of development related to anything: there are different stages of development in terms of viability, connections, services, technologies and RE resources too. There are noticeable hydrogeological differences among Italian regions, different degrees of drought and approaches to renewable resources. As a result, a variety of situations can be noticed all over Italy, with different problems to be faced and different power plants to be implemented according to what extent it is possible to face the needs of the population.

Piemonte is one of the most important Italian regions in terms of hydropower, as it has a very high number of pumped hydro energy storage plants and sources. As a matter of fact, in this area, there are 1447 plants, with 3105 enumerated sources. Plants with a power higher than 200 kW are mostly concentrated in the areas of Novara, Verbania, and Turin. These areas are characterized by noticeable differences in altitude and serve a remarkable number of people. However, more than 50% plants have a potential between 3 kW and 10 kW. The region around Asti has a hilly territory but is not good enough for plants [13].

In Puglia, the production of water in 2008 was equal to 527 mm^3 (almost constant in the last 10 years) and the pumped water was 471,3 mm^3. In the last 10 years two projects have been implemented in this region to increase the amount of energy produced by water and to improve efficiency as it has been foreseen an increasing demand of hydric assets. The problems that have been faced can be divided into three categories: problems related to infrastructures and organization (management problems for the implementation of new plants); hydrologic problems (due to drought, as the region has low availability of hydric resources); problems linked to the quality of water (biological pollution as algal blooms or chemical matters concerning the salinity of water); mechanical problems related to ordinary and planned maintenance of plants. These problems are evidently different from the ones met by the region Piemonte, as this region has a major availability of water and is already at an advanced development stage. Furthermore, whereas plants in Piemonte have reached a "maturity status", and the actions undertaken are finalized to higher levels of efficiency and production, in Puglia new projects are useful to totally change the zone in terms of hydropower, with more dynamic interventions. Many examples are suggested by the "Autorità di Bacino della Puglia" and include: the resignation of hydropower plants such as the one in Castrocucco, the reactivation of crossbeams in Sauro, the use of streams getting to the river Olivento, the connection between the tank in Marascione and the basin in Locone. These interventions entail higher volumes for the tanks in Simmi, Occhito and Locone, with investment costs equal to 130.346.340€ and operative costs by 5.370.000€ [14].

The orographical features of land in Molise make it a perfect area to fit the necessary conditions for pumped hydro energy storage systems as the orogenesis of the Apennines in Molise entail the existence of important bodies of water even at altitudes from 1000 metres on. The particularly favourable territory is the cause of the creation of 4 areas (and a fifth one will soon be realized) where energy is produced using aqueducts. The first area is the so-called "Molisano destro" where water comes from a mountain 500 metres high, then channelled thanks to gravity in a central basin and lifted to a height of 914 metres to use its kinetic energy. The total amount of energy produced in Molise thanks to these 4 areas is equal to 484 kW, which is still too low to face the high demand for energy in the area [15].

Hydropower plants in Friuli- Venezia Giulia were born in the XIX century, characterized by high power: in 1897 a noticeable plant was built for that time, with a power by 10.000 kW. Only at the beginning of the XX century the first small plants were built, and the plants in Tagliamento and Cellina were realized almost as they are nowadays. The climate in Friuli is known for being quite rainy because of the contrast between tropical and polar masses of air: Musi is the point with the highest rate of rain in Italy, with more than 3.000 mm of rain per year. The region is characterized by different hydrographic systems and the most important is represented by the river Tagliamento with its smaller tributaries. From many studies, it results that there are many realized but non-authorized plants (even though with a small power installed) whereas in the west areas of the region new plants and projects are seeing the light. Moreover, the region is trying to use its potential by restructuring old mills in order to increase the region productivity. The average rated power of plants in Friuli are different: in the area of Resia, plants' rated power goes from 31 kW to 1.084 kW, in the area of Gemona del Friuli it goes from 1 kW to 1.632 with a very high spread. Even though the region is efficient, it has not reached the levels of efficiency it could, therefore many projects have been thought and are now in the process of being tested and implemented. As a result, this area, as Puglia, is really dynamic.

A general view on the current status of different regions of Italy [16]:

Table 4. *Hydropower plants' number and power in 2016.*

Region	Number	Power (MW)
Piemonte	820	2720.2
Valle d'Aosta	154	959.4
Lombardia	594	5095.6
Trentino Alto Adige	765	3297.1
Veneto	373	1158.3
Friuli Venezia Giulia	215	502.0
Liguria	80	89.3
Emilia Romagna	170	339.2
Toscana	194	367.5
Umbria	41	511.5
Marche	167	248.4
Lazio	83	405.7
Abruzzo	66	1011.3
Molise	31	87.7
Campania	55	342,.2
Puglia	7	2.9
Basilicata	14	133.3
Calabria	52	771.4
Sicilia	21	131.9
Sardegna	18	466.4
Total	3,920	18,641.3

Source: Gestore Servizi Energetici (GSE), Energia da fonti rinnovabili in Italia, Rapporto statistico, 2016, p. 81

6. Italian Regulations on Pumped Hydro Energy Storage Systems

As water is a common good and a fundamental right, regulations about hydropower in Italy have always dealt with the problem of concessions. In 1885 the right to exploit hydropower plants could last for 30 years with the obligation of paying a periodic licence fee. Nowadays, after the law n. 1643 in 1962 [17], hydropower production has been nationalized and most concessions have been given to ENEL, without any deadlines or any competitive procedures. Many years later, in 1992, the so-called "Decreto Bersani" [18] adopted the changes that the European Community wanted and this entailed considerable changes: regions and autonomous provinces should give hydroelectric concessions, which are temporary. The current discipline for concessions establishes a 20-30 years period for new concessions (after the winning of a competitive procedure) given in return for a periodic fee. The duration of the concessions depends on the entity of the needed investments: interventions of improvement, conservation, environmental and territorial compensation, economic offer for the use of the hydric resource and the eventual increase of energy production or of installed power. Nevertheless, concessions which are disciplined by international agreements still remain under the authority of the State, giving relevance (to award the concession) to: economic offer, increase of energy production or installed power, various interventions.

Nonetheless, it is important to give rules about the use of water to avoid its depletion, excessive use, pollution, reduction in quality and so on. To reach its objectives, the government has adopted international directives, as Italy is part of Europe and water is a common resource that every single Country has to protect. Consequently, the EU directive n. 60 [19], in 2000, introduced a new approach for the use of water, focusing on its protection and on prevention. The main aims are: the improvement of waters protection, the management of hydric resources, the reduction of emissions and creation of quality standards, the engagement of European citizens. Moreover, the European commission published in 2014 a guideline to help European countries to manage at best water resources. These guidelines are useful (and must be followed) by European countries with one general aim: environmental protection. There are specifications as far as it concerns the sectors where governmental interventions are needed: transport, coal, agriculture, forestry, aquaculture and fisheries. Moreover, the European Commission wants European Countries to focus on energy efficiency too: the amount of saved energy ensures higher standards of environmental protection. As a result, the scope of all the implemented actions in favour of the environment is to create a low carbon economic area and a Union energy market, so as to share energy flows and use at best the consequent synergies. So, it is known that, according to economic principles and studies, markets tend to be efficient on their own, but the European Commission thinks that State intervention may improve efficiency in order to reduce negative externalities as much as possible. The principle behind this belief is that when pollution is not adequately priced, who pollutes does not face the full cost of pollution. In this case, the above-mentioned incentives would not work. Moreover, the integration of European Countries markets is pursued by the EU to reduce asymmetric information (that usually occurs when the two sides of the market have different information, causing an increasing of the risk for one of the two parties), to increase and share positive externalities and to avoid coordination failures (to prevent costs due to the development of a project that will not work). These are the main aims of EU concerning one of the most important resources Man has: water.

7. Incentives on Hydropower Plants

As already said, hydropower is one of the most widely spread renewable energy sources and, to encourage even more its spread, an administrative order [20] has ruled new incentives to it. In 2016, the D.M. 23/06/2016 [21] was thought to incentivize further and to improve the rules already set by the previous D.M., as the intention is to spread hydropower plants (both small and big ones) through incentives. The incentives have been set to encourage not only hydropower but wind energy, biomasses, biogases, bioliquids, thermodynamic solar plants and so on. To sum up, the government (in line with EU objectives) wants to focus on renewable energy sources and does it through one of the most spread means: incentives. According to the mentioned administrative order, there are three ways to take part to the plans: direct access, subscription to the "Registri" (registers) or the winning in downward auction competitive procedures. The former is though for small plants (both new ones and existing ones for reconstruction, empowerment or reactivation processes), but the term to take part to the direct access was the 31st December 2017. The subscription to registers is needed for medium plants (again, both new and existing ones): after the enrolment, it is necessary to apply after the realization of the plant. The last one has been thought for large plants: it is necessary to take part to downward auctions to be assigned to the available power and, if succeeding, it is possible to apply definitively after the realization of the plant. In case the project includes empowerment interventions instead of the creation of new plants, the application form can be sent only after the realization of the project (it is to say after the empowerment is realized).

Incentives are recognised according to the net electricity put into the power grid, estimated as the minor value between net production (gross production minus line and transformation losses and auxiliary services consumption) and electricity which is effectively introduced into the power grid. There are two different kind of incentives, depending on the power of the considered plant. The so-called "Tariffa Onnicomprensiva" (TO) or all-inclusive tariffs is a unique tariff remunerating the produced energy and adding to it eventual rewards for the specific plant. The other incentive is the "Incentivo" (I), calculated according to a basic tariff, with slight variations due to variations of electricity prices related to the time slot. Plants with a power up to 500 kW can access both the incentives and have even the possibility to change the kind of incentive, but no more than twice all along the period. Other plants can access only the "Incentivo". They are both distributed by "Gestore dei Servizi Energetici" (GSE) or "energetic services operator" for a specific period that changes according to the plant, since the beginning of the commercial life of the plant. The beginning of the plant's commercial life can be chosen by the operator but cannot be set after more than 18 months since the entry into operation of the plant [22].

Just to give an idea about the amount of the incentives, the following tables show the different basic tariffs (depending on the period and plants' powers) related to the two administrative orders (the D.M. 06/07/2012 and the D.M. 23/06/2016).

Table 5. *Tariffs and Period of Enjoyment of Incentives depending on the Power of Plants, D.M. 06/07/2012.*

	Power (KW)	Period of enjoyment of incentives (years)	Basic tariff (€/ MWh)
Run-of-the-river plants	$1 < P \leq 20$	20	257
	$20 < P \leq 500$	20	219
	$500 < P \leq 1000$	20	155
	$1000 < P \leq 10000$	25	129
	$P > 10000$	30	119
Basin or tank plants	$1 < P \leq 10000$	25	101
	$P > 10000$	30	96

Source: GSE, Incentivazione della produzione di energia elettrica da impianti a fonti rinnovabili diversi dai fotovoltaici, Procedure applicative del D.M. 6 luglio 2012 contenenti i regolamenti operativi per le procedure d'asta e per le procedure di iscrizione ai registri, 24th August 2012.

Table.6. *Tariffs and period of enjoyment of incentives depending on the power of plants, D.M. 23/06/2016.*

	Power (KW)	Period of enjoyment of incentives (years)	Basic tariff (€/ MWh)
Run-of-the-river plants	$1 < P \leq 250$	20	210
	$250 < P \leq 500$	20	195
	$500 < P \leq 1000$	20	150

	Power (KW)	Period of enjoyment of incentives (years)	Basic tariff (€/ MWh)
	1000< P ≤ 5000	25	125
	P > 5000	30	90
Basin or tank plants	1 < P ≤ 5000	25	101
	P > 5000	30	90

Source: www.gse.it [23]

It can be noticed that the two administrative orders are not different only for the basic tariffs but even for the use of different parameters to classify the plants' power.

8. Conclusion

According to what is written in the previous pages, it is evident that Europe wants to become proactive in terms of energy production and Italy is destined to follow the European guide. Statistics have shown that Italy is gradually waking up, embracing the ways to create energy without damaging the world that surrounds Italians. As the growth of Italy from the point of view of renewable energy has been noticeable, Italians can all expect Italy to implement soon better ways to be environmentally friendly. If Italy has been able to embrace green economy even when there were not so many EU guide lines or rules, now, with the increasing number of incentives and binding laws, Italian steps towards green energy will be amazing. Moreover, it should be considered that Italy is full of resources and with the term “resource” it is not meant “oil” nor “fuel”, but green, renewable, unpolluting resources: Italians have the strength of the sea, the energy of the sun, the power of winds, the altitudes of Alpes and Apennines, a perfect climate to exploit renewable energy sources. Italians, in contrast to other populations, have the fortune to have more than one renewable energy source to count on, thanks to the variety of its territory, climate and ecosystems. This is not something that can be underestimated (and, unfortunately, Italians usually do): nowadays Italy cannot afford to be independent in terms of energy production and needs to buy energy from other countries, which is energy coming from nuclear power plants. On the contrary, in the next ten years Italy could start to break these chains and be autonomous, producing green energy [24]. Moreover, if Italians start to be more aware of the treasure they have, Italy could not only be autonomous but even export the excess energy produced. Everything depends of how much Italians believe in renewable energy sources because, after all, the most important resource Italians have is their extraordinary inventiveness.

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